

DLS 200

ISDN WIRELINE SIMULATOR

OPERATING MANUAL

Consultronics

.. dedicated to innovation, quality, and technology.

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DLS 200 ISDN WIRELINE SIMULATOR

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RECEIVED

DLS 200

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Section 1 INTRODUCTION

1.1 ABOUT THIS MANUAL

The DLS 200 Operating Manual can be used to learn about the unit for the first time, or can be used as a "look up" reference book. It is suggested that you carefully read the introduction sections of this manual before powering on your unit. Failure to do this could cause damage to your DLS 200. You will find that this manual is divided into sections as listed in the table of contents.

If you have any questions not covered by this manual, we encourage you to contact your Consultronics sales representative or contact our customer service department at the location shown in the "Service" section of this manual. If you have any suggestions as to how this manual could be improved, please feel free to write to us at the same address.

Thank you for your business and for choosing Consultronics.

1.2 RECEIVING AND UNPACKING THE UNIT

The DLS 200 has been shipped to you in a reinforced cardboard shipping container. It is suggested that you retain this carton for any future shipments.

Inside the shipping carton is a packing list (a packing slip may be attached to the outside of the box, which is for the shipping company only, please refer to the packing list). Please check that you have received all items as per the packing list and report any discrepancies as soon as possible. Please also note that some options are installed within the chassis of the main unit and can only be checked by powering on the unit which is covered in the following section.

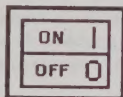
1.3 POWERING THE UNIT

The DLS 200 has been supplied with a universal power supply which will operate on 110V / 60Hz, 220V / 50Hz, 100V / 60Hz or 240V / 50Hz. There is no selection needed for different voltages. Please, however, power the unit only with a power source which falls within the limits indicated on the rear panel. The DLS runs on an internal IBM-PC/MS DOS platform and requires that the supplied disk be inserted into the disk drive in order to operate. MS-DOS Version 3.3 is installed in the unit and supplied on floppies together with the DLS program disk. Since the unit will not operate without these disks, it is suggested that you create a back-up copy before operating the DLS 200. See "CREATING A BACKUP" for details. Use the back-up copy to run the DLS 200.



INSERTING A DISKETTE

Slide the diskette into the disk drive and gently push it into the slot. The disk can only be inserted one way (i.e. the direction of the arrow), so if it does not go in smoothly, try turning the diskette over and re-inserting.



Once the diskette is in and locked, the unit may be powered by moving the rear panel mounted power switch to the ON position. Immediately the disk drive light will come on and then turn off. The display will then be lit. Note that it takes about 30 seconds before the information on the screen becomes legible. During this time the CPU is checking its memory and configuration, and the necessary screen drivers are loaded to configure the EL display. After the above time has elapsed the message in Fig.1.1 will be displayed.

The DLS is now ready to be used.

Loading and Checking
Please wait 1 minute to load program
DLS 200 ANSI Version 2.XX

Fig.1.1a Power Up Message for a fully configured DLS 200

CREATING A BACKUP

The following information applies to the DLS 200 :

- (1) On the Main Menu, select **Quit** and press **ENTER**. This will terminate the DLS operation and transfer the DLS control to DOS, and the DOS prompt "**A>**" will appear on the screen.
- (2) Check that the DLS program disk is in the disk drive and perform the following key sequence : **Num Lock - "2" - Enter**. This will type the number "**2**" at the DOS prompt and will run the disk backup program.
- (3) After a few seconds, the DLS will prompt you for the **SOURCE** disk, which is the same disk already in the drive. Simply press **Enter** and the DLS will start loading the files into its memory.
- (4) After the files are downloaded, the DLS will prompt you again for the **DESTINATION** disk. Follow the instruction in "INSERTING DISKETTE", insert a blank 3 $\frac{1}{2}$ " diskette into the floppy drive and press **Enter**. The DLS will copy the files from its memory to the floppy. If the disk is not formatted the DLS will format the disk before copying the files.
- (5) Once copying is finished the unit will ask if you want to copy another one. If an external keyboard is available, type **Y** for yes if you want to copy another disk, and **N** if you want to end the session. If the session is ended, perform **Num Lock - "1" - Enter** on the DOS prompt to run the program. If a keyboard is not available, power down the DLS and power it up again, the DLS will be reinitialized and the program will be loaded.

Since the DLS comes with only one diskette, it is very important to perform a backup.

Section 2 ISDN BACKGROUND

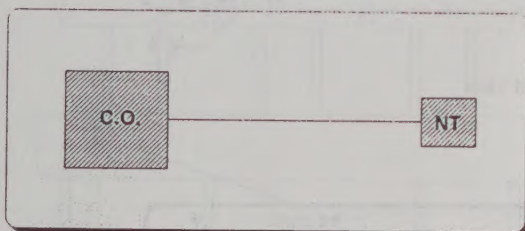
The Integrated Services Digital Network (ISDN) emerged in the late 1970's as a means of integrating different information streams, and re-implementing the analog network at that time into a digital transmission scheme. This development was a result of the demand from corporate users. The ISDN concept materialized when the CCITT (The International Telephone and Telegraph Consultative Committee) employed the concept and started developing a set of standards for a universal Integrated Services Digital Network.

ISDN promises to be one of the greatest evolutions in telecommunications since the implementation of digital services. Though still in its development stage, ISDN has the potential of bringing many applications such as video conferencing, PC-to-PC file transfer, Group IV Fax, and even holographic images to its subscribers. Through the advancement of technology, ISDN advances itself to become a global standard and promises to become the mechanism behind telephone calls and data connections.

ISDN has a very broad specification which includes **Primary Rate** (1.544 Mbps composed of 23 x 64 kbit/sec. "B" channels plus 1 x 64 kbit/sec. "D" channel in N. America, or 2.048 Mbps composed of 30 "B" channels plus 1 "D" channel in Europe), **Basic Rate** (2 x 64kbit/sec. "B" channels plus 1 x 16kbit/sec. "D" channel), and **Broadband** (video / data / voice in various configurations). **Primary Rate** requires a **1.544 Mbit/sec.** connection for its 24 channels (or **2.048 Mbit/sec.** for 31 channels in Europe), and is meant for users who require high-speed communications (e.g. Local Area Network). **Basic Rate** requires a **144 kbit/sec.*** connection for its three channels, and is meant for most end users. **Broadband** can achieve transfer rates of **150 Mbit/sec.** and is meant to integrate with the broadband capability of fibre optics. The distribution of the ISDN signals is complex, as they are being carried by the existing network. For the purposes of this manual, we will concentrate on the distribution of ISDN signals at the basic rate from the central office to the end user site, and more specifically distribution within an end users premise.

* Depending on the interfaces, the total bit rate will be different. For the U interface, the total will be 160kbps; for S/T interface, it will be 192kbps.

2.1 THE ISDN U Interface



To and from the central office, basic rate ISDN signals are sent via 2-Wire twisted copper pair known as the U-Interface. These bi-directional 160 kbps (i.e. 144 kbps with 16 kbps overhead) signals are coded as either a 2B1Q signal, or a 4B3T signal depending on the administration. The DLS is especially suited to simulate line conditions for either of these. The signal is terminated at the customer premises via a **Network Terminator (NT)**.

The DLS 200 simulates the physical parameters of the U interface in order to stress test U interface transmission products.

2.2 ANSI SPECIFICATIONS

ANSI specification **T1.601** describes the physical characteristics of the two wire ISDN U-Interface. Described are the limits (pulse masks etc.) of the signals as they are specified on the U- interface, the physical cable specifications and the testing procedures for devices which connect to the ISDN U-Interface. The DLS 200 is designed to implement this ANSI specification.

Similar specifications have also been drafted by ETSI for the two wire U-Interface, the test loop specifications are employed in the ETSI version of the DLS 200.

2.3 THE DLS 200

The DLS 200 simulates the characteristics of the physical cabling of the ISDN U-interface. They consist of wireline modules which can simulate various lengths of cable (user selectable), impairment modules which can introduce impairments such as noise, crosstalk and impulse noise and a matrix card, which allows the cable type and configuration to be changed. (i.e. bridge taps to be added or subtracted, etc.)

The various elements for the DLS 200 are described below :

Fixed Gauge Wireline Modules
Mixed Gauge Wireline Modules
Impairment Modules

Matrix Card

Two wire simulation of cable selectable in approximately 0.15 kft steps to 7.85 kft maximum. Each card simulates three different gauges of wireline on a single card. Each card injects white noise, shaped noise, 2B1Q crosstalk noise, longitudinal noise, impulse noise, noise bursts and spurious tones onto the simulated two or four wire path. Sets up the connection path between wireline modules. Allows the DLS 200 to simulate 2 & 4-wire circuits. It also allows wire gauges to be selectable and for bridge taps to be added.

2.4 DESCRIPTION

The DLS 200 is a stand alone ISDN U-Interface Simulator. It features a large EL graphic screen, a PC compatible CPU running MS-DOS, open architecture (accepts various modules), and easy-to-operate front panel controls. An external keyboard can be connected, and the unit can be controlled via the IEEE-488 (GPIB) interface *.

* The IEEE-488 interface is electrically the same as the IEC 625 interface in Europe.

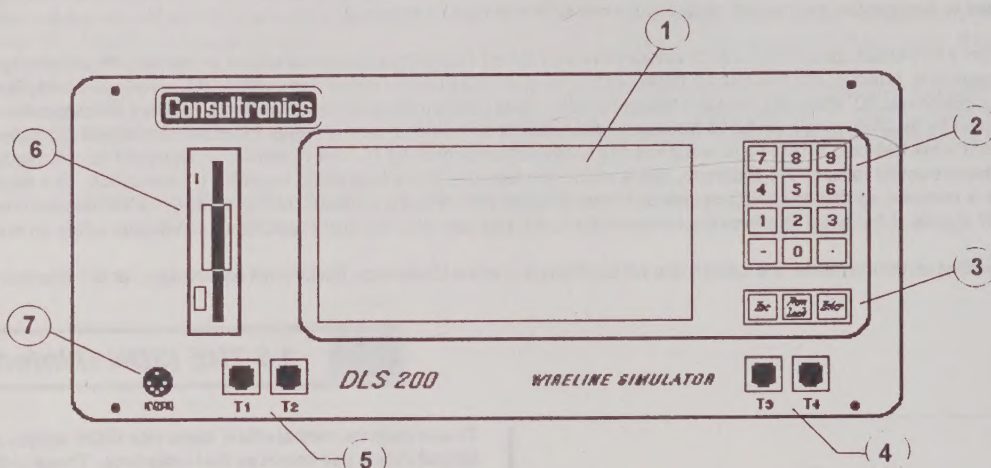


Fig.2.1 Front View

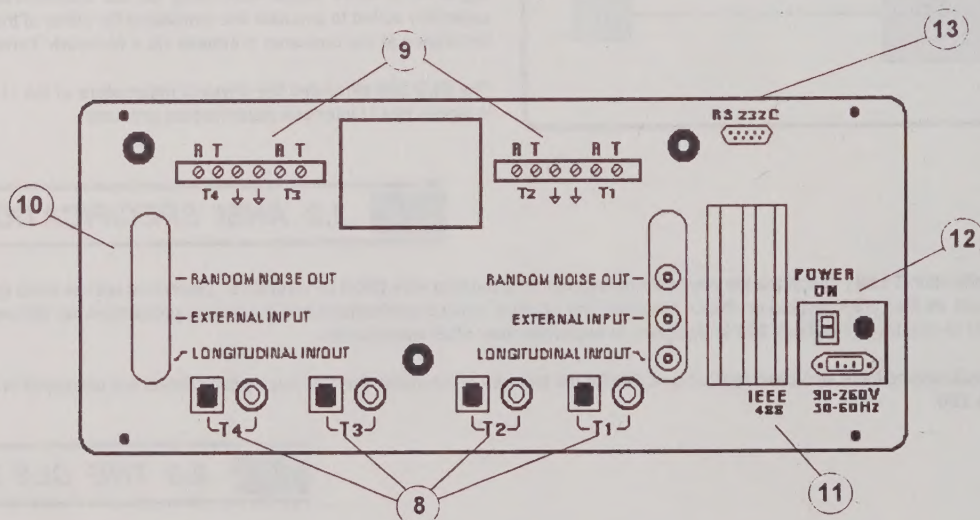


Fig.2.2a Rear View of DLS 200

- | | |
|---|---------------------------------------|
| 1. DLS 200 DISPLAY | 2. KEYPAD / CONTROLS |
| 3. KEYPAD / CONTROLS | 4. RJ45 CONNECTOR FOR T3 and T4 |
| 5. RJ45 CONNECTOR FOR T1 and T2 | 6. 3 1/2" DISK DRIVE |
| 7. EXTERNAL KEYBOARD CONNECTOR | 8. RJ11 & 310 CONNECTORS FOR T1 TO T4 |
| 9. TERMINAL BLOCKS FOR T1 TO T4 | 10. EXTERNAL IMPAIRMENT INPUTS |
| 11. IEEE 488 INTERFACE FOR REMOTE CONTROL | |
| 12. POWER SWITCH AND AC MAINS | |
| 13. RS-232C SERIAL PORT INTERFACE | |

There are provisions for connection to the equipments to be tested on the front and back panels of the DLS 200. Both front and back panels have RJ45 connectors.

Transmit (TX) and Receive (RX) connections of the RJ45 connectors are wired in parallel, therefore connecting to T3 at the front is the same as connecting to T3 at the back panel.

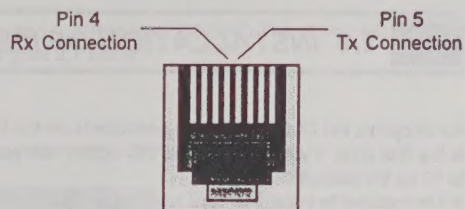


Fig.2.3 RJ45 (2 wire) Connector Pinout Diagram

2.5 CONFIGURATION

DLS 200 Multigauge Cards (22, 24 & 26 AWG)

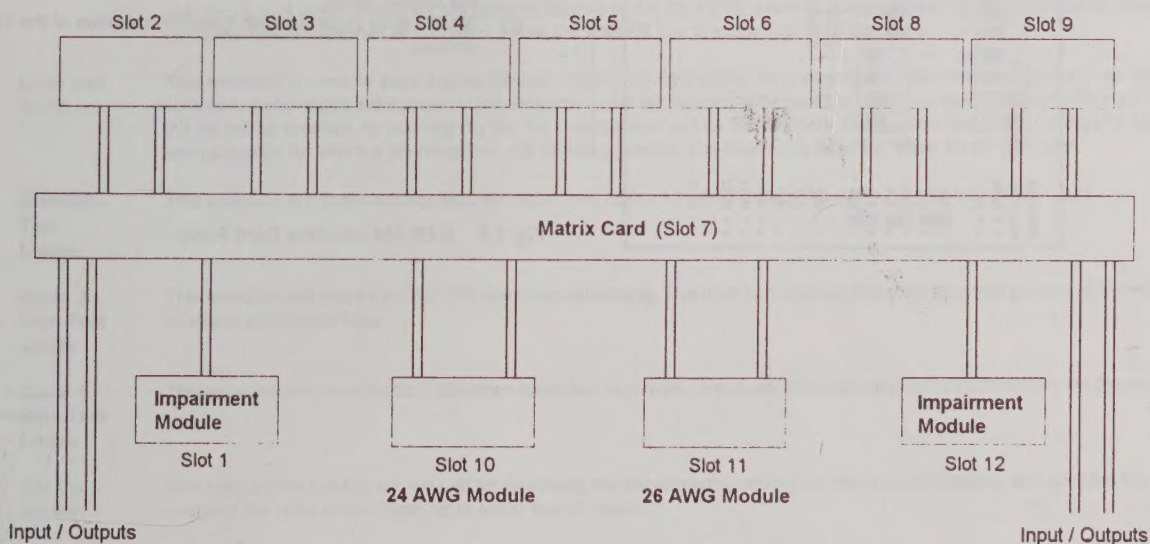


Fig.2.4 DLS 200 Wireline Card Configuration

The DLS 200 wireline cable using passive components such as capacitors, resistors and inductors. This allows for bi-directional re-creation of the actual characteristics of twisted copper pair wire. In order to select different lengths of cable, the DLS 200 varies the length of the simulating gauge using relays. These sections and relays are contained on the wireline cards.

The DLS 200 Configuration

The DLS 200 allows for different connection paths to be simulated. These paths could be a straight 4-wire path, a straight 2-wire path, or a 2-wire path with attached bridge taps. These paths could be of a single gauge of wire, or of mixed gauges. The path that is established through the DLS 200 is set by the Matrix Card. It contains a number of relays which can either route a signal through a particular card or bypass it. The Matrix card also determines the order of modules through which the signal passes, and the location of bridge taps.

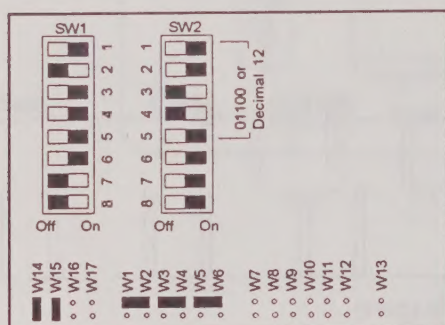
The impairment cards in the DLS 200 injects different types of noises : simulated crosstalk noise, longitudinal noise, powerline noise and impulse noise onto the wireline path. Each simulated impairment can be enabled or disabled by the user and the parameters of the impairments (such as level) can also be varied. When the DLS 200 is in the four wire mode, the impairments are placed on the receive pair at each end of the circuit. In the two wire mode, the impairments are placed at both ends simultaneously.

2.6 INSTALLATION OF IEEE 488 BUS

As an option, the DLS 200 may be controlled over the IEEE 488 bus by installing an interface card. Installation of the card should be simple and is the first step. If you have ordered this option with your unit originally, then the card will come already installed. The IEEE address will be set to 12 as the default.

If it is required to install the card or change the address, proceed as follows :

- (1) Remove the top cover of the unit using a hex screw driver.
- (2) Set the switches and jumpers on the card on the diagram below. This sets the card to an IEEE address of 12, prevents the 1444A from asserting IFC or REN, and enables open collector operation of the drivers. To change the address, set switches SW2-1 to SW2-5 using binary numbering. Position 5 is the most significant bit and position 1 is the least significant bit.
- (3) Remove card blank covering IEEE slot (refer to item 11 in Section 2.4).
- (4) Insert the card into the short IBM PC type slot of the DLS 200. Secure the card in place at the end tab by using the screw provided at the back of the DLS 200.
- (5) Replace the cover of the DLS 200.



- a.) Take out W13 shunt (used for grounding).
- b.) SW2-8 is on (disables IFC and REN line from being asserted by the Ziotech card).
- c.) SW2-7 is on (enables open collector operation of the interface drivers).

Fig. 2.5 IEEE 488 Interface Card Setup

Section 3 OPERATION

In order to operate the DLS 200, it is necessary to follow the procedure outlined in section 1.3 "Powering the Unit". The screen will then display the last used configuration. Pressing the ESC key will display the menu shown in Figure 3.1 below :

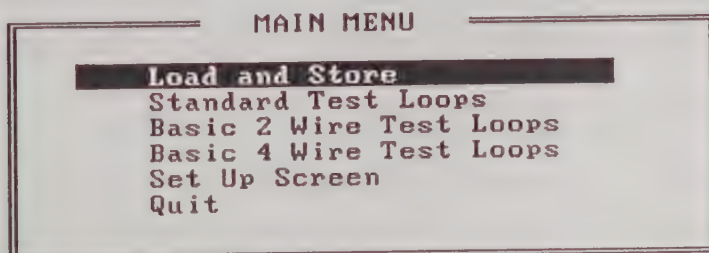


Fig. 3.1 DLS 200 Main Menu Display

Main Menu	Presented on the main menu of the DLS 200 upon power-up are a number of selections. To choose one of the selections, use the up and down arrows on the numeric keypad of the DLS 200, which is located to the right of the graphic display. Once the desired function is hi-lighted, press the ENTER key to make that selection.
Load and Store	This selection is used to store and recall user created configurations. By pressing ENTER when the cursor is on this selection, a sub-menu will appear for the selection of the file location to be recalled or written to. By pressing the Pg Up key the file will be recalled, by pushing Pg Dn, the configuration will be stored. Note that there is a specific location for storing configurations for which a file name has not yet been created, this location is labelled "Save New File Here".
Standard Test Loops	This selection will automatically load and select any of the 16 standard test loops as defined by ANSI T1.601.
Basic 2 Wire Test Loops	This selection will place the DLS 200 into a two wire mode. The user can then set the distances and gauges of the various wirelines and bridge taps.
Basic 4 Wire Test Loops	This selection will place the DLS 200 into a basic four wire mode. As above, this mode is used to build custom configurations.
Set Up Screen	This selection is used to set the unit for displaying the impairments, setting the screensaver feature, and allowing the user to select the units to be displayed in either feet or meters.
Quit	This selection is used to exit the main menu and go to a DOS prompt.

3.1 GENERAL OPERATION

Moving The Cursor

Operating the DLS 200 can be accomplished through the keypad.

Left / Right arrow keys	highlight different sections of the wireline path. When a section is highlighted, its corresponding setting is also displayed on the menu.
Up / Down arrow keys	when a section is highlighted, its settings are displayed. These keys allow the operator to highlight the settings and make changes.
PgUp / PgDn keys	PgDn & Pg Up allow you to scroll through the 16 standard test loops.
Enter / ESC keys	ENTER changes (or selects) a setting, and ESC exits a menu when changes are done.
Home key	Sets the current loop displayed to its default settings.
Ins key	Displays the Impairments Menu and allows the user to configure the impairments.

To exit the DLS 200 program and get into DOS, press **Esc**, then move the cursor to the location marked **QUIT**. To return to the DLS program, press **Num Lock**, "**1**", and then **Enter**. If an XT compatible keyboard is connected, extra functions of the DLS 200 can be accessed as the instrument is a full featured PC.

Screen Saver

The DLS 200 is designed with a screen saver to extend the life of the display. Screen blanking time can be varied by the user.

To change the screen blanking delay press **ENTER** while the cursor is located on **setup**. A menu will be displayed allowing the screen saver delay and the units used in displaying impairments to be changed. Highlight **SCREENSAVE DELAY**, press **Enter** and another menu will be shown. On this menu a value of 0 to 60 minutes can be entered; enter the time desired from the numeric keys and press **Enter**. Screen blanking will occur after the DLS is left idle for the preset time. After the screensaver takes effect a cursor will scroll across the screen. Any key pressed afterward will return the display to its setup screen.

After the screen saver delay time is entered, the user can return to the setup screen by pressing **Esc** or **Enter**.

The screensaver can be deactivated by entering 0 minute delay time.

Impairment Units

The DLS 200 allows internal or external impairments to be injected into the bus to simulate "real life" conditions. When impairments are being configured (see Section 3.2.4), the levels can be displayed in volts or dBm, depending on the user's preference. The unit is changed through the **Set Up Screen** menu, following the similar method in setting up the screen saver. On the **Set Up Screen** menu, highlight **IMPAIRMENT UNITS** and press **ENTER**, another menu will be shown. Select the desired unit and press **ENTER**. The selected unit will be used for displaying crosstalk impairments.

Length Units

This selection allows the unit used in the bus length to be changed. The user can choose either kilofeet or meter. Note that this selection is only valid in Basic 2 Wire and Basic 4 Wire loops. the Standard test loops will always be displayed in kilofeet.

SCREENSAVE DELAY
IMPAIRMENT UNITS
LENGTH UNITS

Value (0 - 60) min
3 min

SCREENSAVE DELAY
IMPAIRMENT UNITS
LENGTH UNITS

dB
Volts

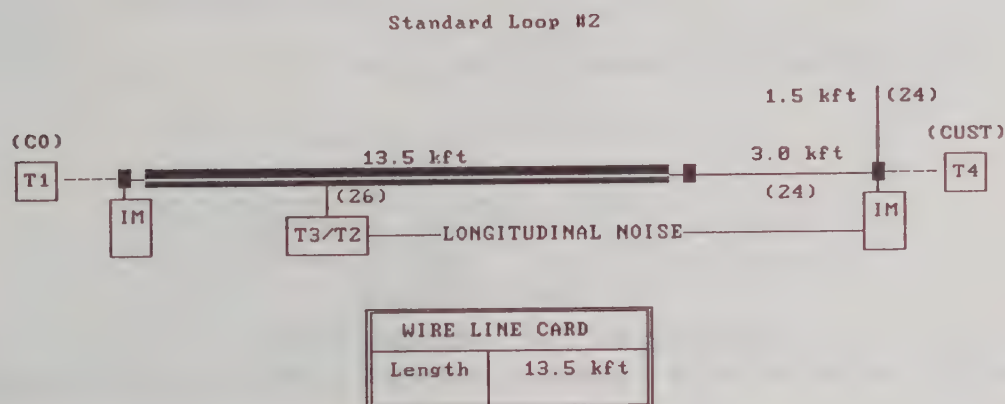
SCREENSAVE DELAY
IMPAIRMENT UNITS
LENGTH UNITS

FEET
METERS

3.2 DETAILED OPERATION

3.2.1 Selecting One of the 16 Standard Test Loops

The DLS 200 can simulate the electrical characteristics of the two wire loops described by ANSI T1.601. When the unit is first powered-up, it automatically loads one of the 16 standard test loops and sets up the DLS 200 to the last loop saved. If no loop has been saved, it will bring up a demo loop (See Fig 3.2). If you are already in another menu of the DLS 200, press ESC, to return to the main menu, move the cursor to the Standard Test Loops, and press ENTER.



ESC=quit PGUP/PGDN=nxt loop <- ->=move <CR>=change HOME=default loop INS=impair

Fig. 3.2 Loop 2 of the 16 Standard Test Loops

The DLS 200 is now displaying a schematic representation of loop #2. The box on the left most portion of the screen, (marked T1) is the modular connector marked T1 on the front panel of the unit. The box on the right most portion of the screen is the modular connector on the front panel marked T4. The horizontal and vertical lines represent simulated wirelines and the boxes marked IM represent the impairment modules.

A cursor is displayed on the first section of the wireline. Pressing the right and left arrow keys will move the cursor to the next section of wireline. The length and gauge of the wireline are displayed in a box below the diagram. To change any value, move the cursor to the section to be changed and press enter. The cursor will jump to the box below the diagram, and you will be able to use the left/ right arrow to change the value. Once the desired value is selected push the ENTER key to enter the value and return the cursor to the diagram.

To select a loop other than loop number two, press the Pg Up / Pg Dn keys. The DLS 200 will automatically select the next loop; however, the impairments remain unchanged.

To add impairments to the simulated loop, see section " 3.2.4 Setting Up Impairments ".

3.2.2 Selecting a Basic 2-wire Configuration

To select a basic two wire configuration, go to the main menu and move the cursor to the section **Basic 2 Wire Test Loops** and press enter. A 2 wire configuration will be displayed which has no length to it. Custom configurations can be built by moving the cursor to each section that needs to be changed. To change a length or gauge, follow the same procedure as is outlined in the section for the standard test loops. Figure 3.3 shows the basic two wire configuration.

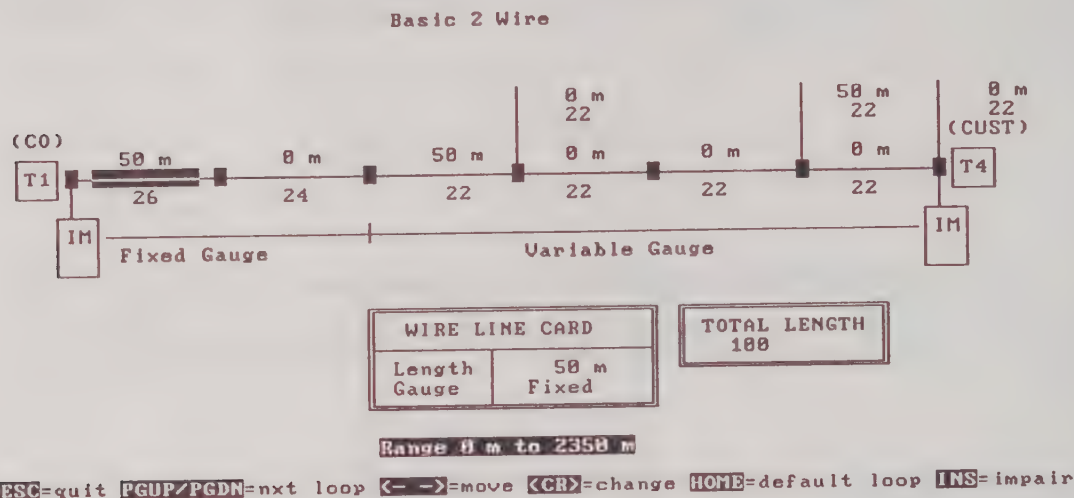


Figure 3.3 A Basic Two Wire Configuration

Fixed Gauge Section

Only the length can be varied for the fixed gauge section, the gauge type cannot be changed.

Variable Gauge Section

Both the length and the gauge can be changed. 22, 24 or 26 gauge can be selected.

Adding Bridge Taps

Bridge taps are sections of wire that connect to, but are not part of the regular signal path of a two wire circuit. They are normally caused by the inadvertent connection of twisted pair to the circuit. On the DLS 200, bridge taps are displayed as vertical lines. If these sections are set to 0 length, it is the same as having no bridge tap at that point. By changing the distance, you can program the length of bridge taps that are needed.

Choosing Other Basic Loops

By pressing the Pg Up / Pg Dn keys, the user can scroll through other configurations of Basic 2 Wire. The titles are :

Max. Length 22AWG (2-W)
 Max. Length 24AWG (2-W)
 Max. Length 26AWG (2-W)
 Max. Length (2-W)

To store a 2-wire configuration, see the section on Saving and Loading Configurations.

3.2.3 Selecting a Basic 4-Wire Configuration

To select a basic four wire configuration, go to the main menu and move the cursor to the section **Basic 4 Wire Test Loops** and press enter. A 4-wire configuration will be displayed. Similar to the 2-wire test loops, custom configurations is built by moving the cursor to each section that need to be changed. To change a length or gauge, follow the same procedure as is outlined in the section for the standard test loops. Figure 3.4 shows the basic 4 wire configuration.

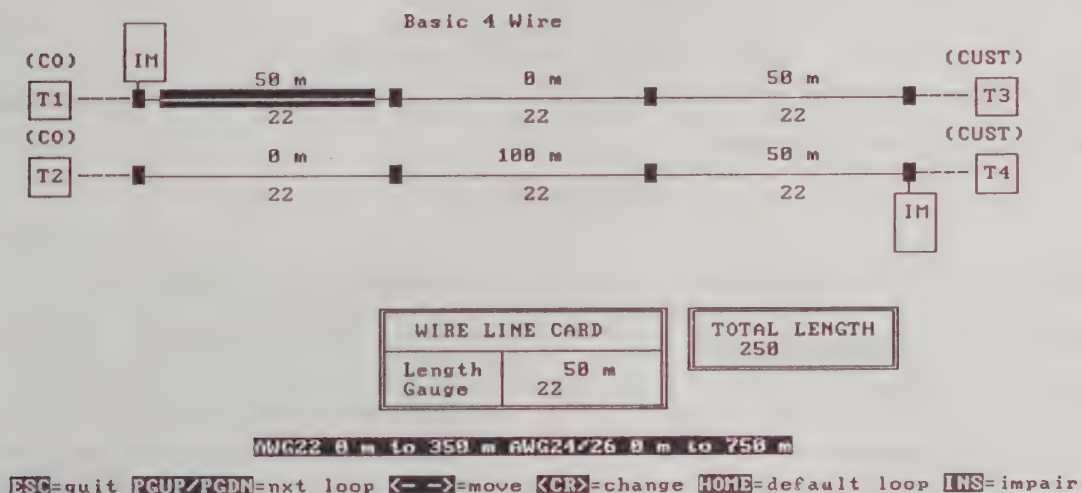


Figure 3.4 A Basic Four Wire Configuration

Both the length and the gauge can be changed on each section. 22, 24 or 26 gauge can be selected. Only one type of test loop is available for 4-wire, pressing the Pg Up / Pg Dn will have no effect on the configuration.

To store a 4-wire configuration, see the section on Saving and Loading Configurations.

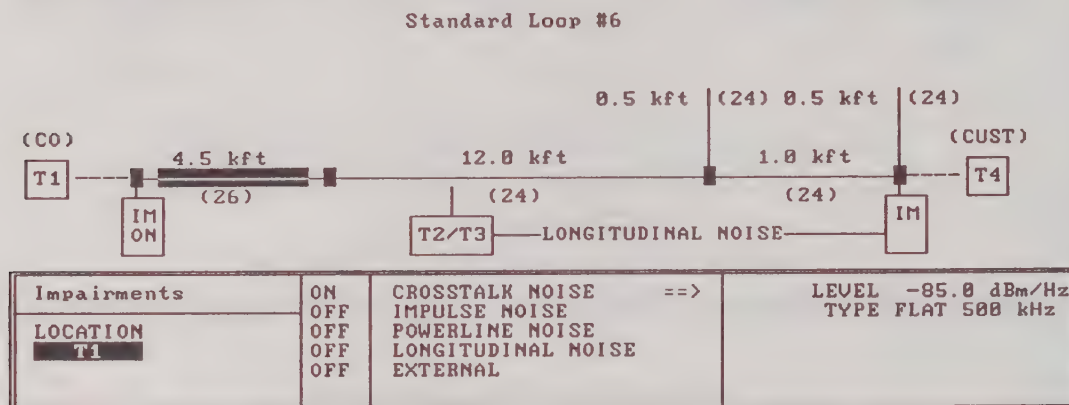
3.2.4 Setting Up Impairments

Impairments can be injected at either T1 or T4 with an impairments module. If a module is installed at either node, this is indicated on the front panel as a box labelled "IM". To set up impairments, display any loop and press the INS key. A menu is displayed that shows the impairments that can be injected, and the node. The DLS 200 is capable of injecting 4 groups of noises and accepting external impairments :

- (A) Crosstalk Noise
- (B) Impulse Noise
- (C) Powerline Noise
- (D) Longitudinal Noise
- (E) External Impairments

On this menu, use the Left/Right arrows to move between columns, and the Up/Down arrows to move between rows and change settings.

Here is a typical screen showing impairments :



Press CR/Enter to select

ESC=quit <- ->=move <CR>=change HOME=default T1

First Column :

The leftmost column indicates the location of noise injection. This is either T1 or T4.

Second Column :

The next column indicates whether any of a group of impairments is on or off.

Third Column :

The right middle column shows the groups of impairments currently available.

Fourth Column :

The far right column shows the type, value(s), and attributes of impairments currently selected.

To Set Or Change An Impairment:

- (1) First go to the leftmost column and press **Enter** to select the location where it is to be injected (i.e. T1 or T4).
- (2) Then use the arrow keys to go to the third column and select the correct group of impairments. Press **Enter** or use the Right arrow to go to the fourth column.
- (3) Then use the Up/Down arrow keys if necessary to select the correct type, level, or attribute to be set. Press **Enter**. This either toggles the field to be changed, or highlights a portion of the field.
 - (a) If it toggles the field, keep on pressing **Enter** to get to the correct selection. When the selection is correct, use the arrow keys to continue.
 - (b) If it highlights a portion of the field, you can change the field, either by using the Up/Down arrow keys, or by pressing NUMLOCK and typing in a value. When the field is correct, press **Enter** to confirm the value. The highlight reverts back to cover the whole field. Use the arrow keys to continue.
- (4) After you have finished changing one impairment press the Left arrow to go back to the third column. Each impairment may be edited using the same procedure. When all editing is finished, press **Esc** to exit the menu.

For more details, see the examples on the page that follow.

External Impairment Input :

There are 3 BNC connectors on the back of the DLS 200 for each impairment module installed (see figure 2.2 in section 2.4). They are used as follows :

(a) **Random Noise In / External Out connectors**

The top two BNC connectors allow external filtering of white noise. This can be made to come out of the External Out connector, fed through an external filter provided by the user, and fed back into the DLS 200 by the Random Noise In connector.

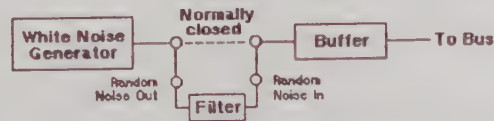


Fig 3.5 White Noise Filter

(b) **External In Connector**

The BNC connector allows external impairments to be injected. Either an analog or impulse can be applied. The analog signal has to be in the frequency range of 100 Hz to 700 kHz with maximum level of 7.5 volts peak to peak. For a fairly symmetric analog signal a maximum level of 10 volts peak to peak can be used. The signal is buffered and applied to the simulated line.

The impulse signal has to be CMOS compatible, and can be initiated by the rising edge of a 5 volt signal. The maximum rate is 2000 per second.

When external impairments are injected, the input has to be internally enabled by the DLSs External Input setting. The setting is located on the bottom of the menus middle column, it can be changed from "EXTERNAL SIGNAL" to "EXTERNAL HIT TRIGGER", or switched off. EXTERNAL SIGNAL is selected when the analog signal is injected, and EXTERNAL HIT TRIGGER is selected when an impulse is applied. Edit the External Input setting just like the other impairments and ensure the impairment source is connected to the back to enable the input.

(c) **Longitudinal In/Out Connector**

If longitudinal impairments are set, a 50 Hz or 60 Hz triangle wave signal is available on the bottom BNC connector, for use externally if desired.

External waveforms can be injected at this connector also, if longitudinal impairments other than the standard ones are needed.

To do this, go to the Longitudinal group of impairments. Press Enter to get to the fourth column. Turn off the level, if it is on. Scroll to the bottom of this column and turn on external.

Crosstalk Noise

Impairments	ON	CROSSTALK NOISE ==>	LEVEL -85.0 dBm/Hz
LOCATION	OFF	IMPULSE NOISE	TYPE FLAT 500 kHz
T1	OFF	POWERLINE NOISE	
	OFF	LONGITUDINAL NOISE	
	OFF	EXTERNAL	

Fig. 3.6a Crosstalk Noise Setup Menu

There are 4 types of noises under this heading : DLS Next, HDSL Next, ANSI Full BW, and Flat 500 kHz.

Impulse Noise

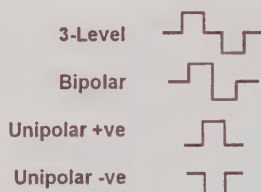
Impairments	OFF	CROSSTALK NOISE		RATE	0 pps
LOCATION	ON	IMPULSE NOISE ==>		LEVEL	50.0 mV
T1	OFF	POWERLINE NOISE		SHAPE	3-LEVEL
	OFF	LONGITUDINAL NOISE		SINGLE	
	OFF	EXTERNAL			

Fig. 3.6b Impulse Noise Setup Menu

The **rate** sets the pulse-per-second rate from 0 to 100 pps.

Single shot appears when the rate is set to 0 pps. On this setting, each time Enter is pressed, a single impulse of the selected type is sent. The **level** can be set from 0.1 to 100.0 mV. Entering a value of "0" or any other value entered beyond the above limits will cause the impairment to be turned off.

The **shape** can be any of the following :



The pulse width can be set in 2 μ sec. increments from 22 μ sec. to 120 μ sec.

Powerline Noise

Impairments	OFF	CROSSTALK NOISE		TYPE	ANSI
LOCATION	OFF	IMPULSE NOISE		LEVEL	8.0 dB
T1	ON	POWERLINE NOISE ==>		TONE #1	50 Hz
	OFF	LONGITUDINAL NOISE		TONE #2	250 Hz
	OFF	EXTERNAL		FREQUENCY	50 Hz

Fig. 3.6c Powerline Noise Setup Menu

There are two types of powerline noise : **SINGLE** and **ANSI**.

When **SINGLE** is selected, a single sinewave is generated.

The level can be set from -40.0 to -100.0 dBm. Entering a value of "0" or any other value entered beyond the above limits will cause the impairment to be turned off.

The tone frequency can be set from 1Hz to 1kHz.

When **ANSI** is selected, two harmonically related sinewaves are generated.

The two frequencies can be the fundamental (i.e. 50Hz) and any of its odd harmonics up to the 11th harmonic (i.e. 150, 250, 350, 450, 550Hz).

As specified in ANSI T1.601, the relative tone levels are as follows :

Fundamental	50Hz	12dB
3rd Harmonic	150Hz	10dB
5th Harmonic	250Hz	0dB
7th Harmonic	350Hz	-6dB
9th Harmonic	450Hz	-11dB
11th Harmonic	550Hz	-15dB

The level can be set from 9 to -15dB relative to the ANSI specified levels in 0.1dB steps.

Longitudinal Noise

Impairments	OFF	CROSSTALK NOISE	LEVEL 20 Vrms
	OFF	IMPULSE NOISE	FREQUENCY 50 Hz
LOCATION	OFF	POWERLINE NOISE	EXTERNAL ON
T4	ON	LONGITUDINAL NOISE ==>	INJECTION MID POINT T3
	OFF	EXTERNAL	

Fig. 3.6d Longitudinal Noise Setup Menu

Longitudinal Noise can be injected on T4 of the DLS.

The level can be set from 1 to 60 Vrms in 1V steps. When the level is set to 0, an external signal can be enabled at the External Off line. The frequency can be set to 60 Hz or 50 Hz.

It should be noted that Longitudinal noise can be injected at T4 only.

External Input

Impairments	OFF	CROSSTALK NOISE	EXTERNAL SIGNAL
	OFF	IMPULSE NOISE	ATTEN 10.0 dB
LOCATION	OFF	POWERLINE NOISE	
T1	OFF	LONGITUDINAL NOISE	
	ON	EXTERNAL ==>	

Fig. 3.6e Externally Injected Impairment Setup Menu

On the External Hit Trigger setting, an impulse generator can be connected.

When External Input is set to External Signal, the analog signal can be applied.

When set to Externally Filtered Crosstalk Noise, the internally generated crosstalk noise is directed to the top (Random Noise Out) connector.

It can be filtered and applied back to the middle (External Input) connector if desired. See also section 3.2.2 Random Noise In/Out Connectors.

When in External None, no impairments will be taken from the top two BNC connectors. The bottom connector, for Longitudinal In/Out, will stay active.

3.2.5 Saving and Loading Configurations

During the set-up of any configuration, pressing **ESC**, moving the cursor to the Load and Store position, and pressing **ENTER** allows you to enter the **Load and Store** menu. The menu can be used for saving the current edited configuration or loading new configurations from disk.

Loading Configurations :

Use the **Up / Down** arrows to highlight the configuration to be loaded and then press **PgUp**. The disk drive LED will come on for a moment as the DLS 200 loads the selected configuration from disk. After a few seconds, the selected configuration will be displayed.

Saving Configurations :

Edited configurations can be saved on disk as new configurations. To save an edited configuration, use the **Up / Down** arrows keys to highlight **"Save New file here"**. Press **PgDn** and a line on the bottom of the screen will come up prompting for the new configuration's name. Use the **Up/Down** arrows to change characters, **Left/Right** arrows to move to adjacent spaces (or type in the name if an XT compatible keyboard is available). Press **Enter** when finished to accept the name. The configuration will be saved and listed on the menu.

Edited configurations can also be saved under one of the listed configurations. To do this simply highlight the configuration desired and press **PgDn**. A line will come up displaying the selected configuration name to be saved. If no change is required, simply press **Enter** and the new configuration will overwrite the old one. If changes are required the name can still be altered, but the old name will not be saved.

Anytime during saving a configuration, pressing **Esc** will cancel the operation.

Removing A Configuration :

To remove a configuration from disk simply highlight the configuration to be deleted. Press the **Del** key and the DLS will come up with a message asking for confirmation. Press **Del** again to confirm delete and the configuration will be removed from the disk. Pressing **Esc** will cancel deletion.

Resetting The DLS200 :

Press the **Home** key will display the message "Press **HOME** again to reset to power up values. Press **ESC** to abort." Press **Home** again will reset the unit to its default values.

Exit The Store and Recall Menu :

Pressing **Esc** will exit the menu and return the operation back to bus editing.

Load and Store	Loop 1 Modified
New Configuration :	Loop 2 Modified Lng
Home - default values	Loop 2 Modified Sht
Pg Up - recall file	Save New file here
Pg Dn - store file	
Esc - main menu	
Del - delete file	

Fig. 3.7 Saving and Loading Configurations

3.3 ABOUT IMPAIRMENTS

This section provides some of the background information on how the impairments are injected on the wireline loops.

- (1) **Most impairments are injected on the line in metallic (differential) mode.** All impairments except for the special Longitudinal (common) mode are applied between the 2 wires carrying the signals under test.
- (2) **Most impairments are injected on to the simulated line from a high impedance source of 4.05 kOhms.** Sometimes this is called a "current source". It means that the generator has very little effect on signals travelling on the simulated wireline. It also means that if you measure the level of the signals coming from the DLS 200 impairments module, the level you measure depends on the impedance of the load that you use.
- (3) **The circuit for injecting differential mode impairments is shown here:**



- (4) When setting up the system, many people want to completely disconnect an impairments generator from the loop. This is done automatically with a relay when all impairments from that generator are switched off. You can check this on the screen of the DLS 200. Look at the box containing the letters "IM". If the word "ON" is present below the "IM" then the generator is still connected to the simulated line. When the word "ON" goes away, a relay has disconnected the generator.
- (5) **Several different types of units of level are used (dBm, dBm/Hz, Volts, etc.)** There is a short appendix at the back of this manual about why we have to do this, and how to "translate" from one system of units to another. Wherever possible, we indicate in the paragraphs below, the levels recommended by standards bodies for testing purposes. Also in the main menu there is an item which gives the user a choice of units. This may help you to pick units that are more meaningful to you.
- (6) **Information on the Crosstalk Noise spectrums.**
The crosstalk noise generator uses a pseudo random signal with a bandwidth up to 600 kHz and a Gaussian level distribution. It has a peak to average ratio of 5. All four of the spectrums are filtered versions of this noise.

a) Flat is white noise in the bandwidth 100 Hz up to 500 kHz.

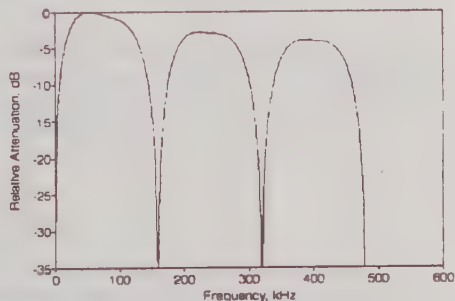
b) **ANSI FULL BW** is crosstalk noise as to ANSI specification T1.601, up to 500 kHz. The specification calls for a total power of -44.2 dBm in a bandwidth of 320 kHz when measured using the load specified by T1.601. This level is our calibrated "Reference Level". You can select a few dB up and down relative to this level. For instance, if you select Relative -2.2 dB, the level is -46.4 dBm in a 320 kHz bandwidth.

c) **DSL NEXT** is crosstalk noise recommended by Bellcore in T1E1.4/93-029 to the ANSI T1E1.4 committee. It represents an interfering signal from a Basic Rate, 2B1Q, ISDN type of signal that could be present in a 25 pair or 50 pair cable. The power in this spectrum is contained almost completely within the bandwidth 0 to 160 kHz (refer to section 8 - Specifications). Bellcore recommends that if the wideband transmit level of each ISDN signal is 13.60 dBm, then the interference in a 25 pair binder group could be -52.62 dBm, and in a 50 pair binder group could be -50.90 dBm.

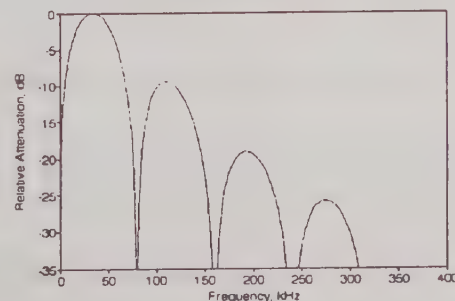
We calibrate DSL NEXT over a frequency range greater than 160 kHz and indicate the level in dBm on the front panel.

d) **HDSL NEXT** is crosstalk noise recommended by Bellcore in T1E1.4/93-029 to the ANSI T1E1.4 committee. It represents an interfering signal from an HDSL, 2B1Q type of signal that could be present in a 25 pair or 50 pair cable. The power in this spectrum is contained almost completely within the bandwidth 0 to 392 kHz. Bellcore recommends that if the wideband transmit level of each ISDN signal is 13.60 dBm, then the interference in a 25 pair binder group could be -44.02 dBm, and -42.30 dBm in a 50 pair binder group. The spectrum is shown in section 8 - Specifications.

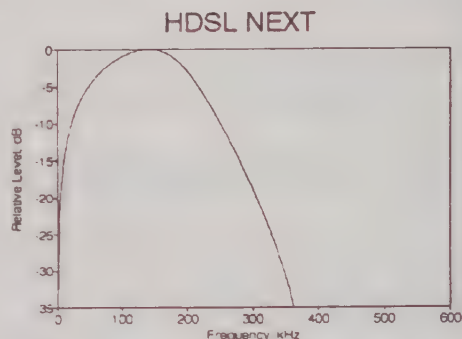
NEXT, ANSI Full BW



DSL NEXT



We calibrate HDLSL NEXT over a frequency range greater than 400 kHz and indicate the level in dBm on the front panel.



- (7) Impulse Noise shapes can have several "shapes". They can be any of the following :



and the pulse width, τ , can be set in 2 μsec increments from 22 μsec to 120 μsec . The pulse amplitude can be varied.

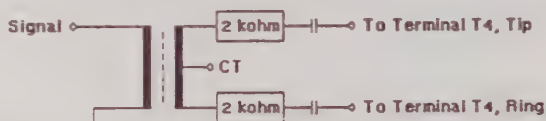
Since there is room for 2 Impairment Modules in the unit, impairments can be added at both ends of the simulated line. The impairments are added in differential (metallic) mode from a high source impedance, however the longitudinal noise is added in a common mode. The level of all impairments can be individually controlled over a wide range.

- (8) There are two types of Powerline Noise.

- (a) Single tone is fairly self evident, and is injected at a specific power level in dBm.
- (b) ANSI, or Dual Tone consists of two harmonically related sine waves. They are any two frequencies from the fundamental and odd harmonics up to the 11th of either 50 Hz or 60 Hz. The level can be set between +15 and -9 dB relative to ANSI specified level. At the ANSI specified level, the selected tones are injected at these levels:

Frequency, Hz	60	180	300	420	540	660
Level, dBm	-47	-49	-59	-65	-70	-74

- (9) Longitudinal noise is presently injected at the centre tap of the transformer shown here.



If longitudinal voltage is not injected the CT is left to float. The 2.00 kOhm resistors are well matched and the series capacitors are large and quite well matched to reduce introduction of differential mode. Longitudinal voltage is a triangle wave at a user-selectable fundamental of 60 Hz or 50 Hz.

Section 4 IEEE COMMANDS AND OPERATION

INTRODUCTION

As a standard feature the DLS 200 has incorporated IEEE 488 Control. This allows it be controlled by a computer and to be integrated into a larger test system.

The DLS 200 IEEE 488 control is designed with several standards in mind.

- A) The physical interface follows IEEE 488.1, implementing the functions outlined in section 4.4.1) "488.1 Interface Functions Supported".
- B) The command structure follows IEEE 488.2 with one small exception, the Listening functions are not universally forgiving. The restrictions on the data formats are outlined in section 2b) Data Formats.
- C) The Device Dependent Commands (section 4) have been designed with the Standard Commands for Programmable Interfaces (SCPI) in mind. However, since there are no SCPI commands that apply to the DLS 200, all the device dependent commands are unique to it.

4.1 GENERAL

4.1.1 488.1 Interface functions supported

The IEEE 488.1 Interface functions supported by the DLS 200 are:

SH1	Source handshake - full capability
AH1	Acceptor handshake - full capability
T5	Basic talker - serial poll, untalk on MLA
L3	Basic listener - unlisten on MTA
SR1	Service request - full
DC1	Device clear - full
C4	Respond to SRQ
E1	Open Collector drivers

These represent the minimum required to implement the 488.2 standard.

4.1.2 Data formats

The DLS 200 adheres to the IEEE 488.2 principle of "Forgiving Listening and Precise Talking" with one exception. The device listening format used in the DLS 200 (Decimal Numeric Program Data-<NRf>) does not support exponential representation of numeric data. Any other representation using +/- signs, optional leading digits, decimal points, and optional trailing digits is acceptable.

Within that framework the data formats supported by the DLS 200 are:

Listening :	a) <NRf> Decimal Numeric Program Data
Talking :	a) <NR2> Numeric Response Data - Fixed Point
	b) Arbitrary ASCII Response Data

<NRf> and <NR2> are simply generic integer representation formats. Arbitrary ASCII Response Data is a generic character string without any delimiting characters. It is usually used to send data in response to a query. In the case of the DLS 200 it is used with the *IDN command.

4.1.3 Command Formats

The DLS 200 adheres to the IEEE 488.2 format for command syntax. As with the Data Format the principle is forgiving listening and precise talking.

A) Commands

Commands may take one of two forms, either a Common Command or a Device Dependent Command. The format of each is detailed in subsequent sections (4.2 and 4.3 respectively). Each type may be preceded by a white space, and each will have a white space between its mnemonic and the data associated with it.

Device Dependent commands are preceded by a colon, with a colon separating each level of the command.

Common commands are preceded by an *.

Several examples are shown below.

```
*RST
:SET:CHANNEL:LOOP1
*ESE 45
```

Messages TO the DLS 200 may be terminated with either a Line Feed character (ASCII dec 10), an IEEE EOI signal or both. Messages FROM the DLS 200 are always terminated with both.

Since all the commands for the DLS 200 have only one piece of data there is no Data Separator specified. (normally a comma ,).

Commands may be either in Upper or Lower case.

B) Queries

Queries of the system follow the same format as the commands, except that the data normally associated with the command is replaced with a question mark ?. Following receipt of such a command the DLS 200 will place the appropriate response in the output queue where it can be read by the controller.

Examples are : *IDN?
 :SET:CHAN:LOOP1?

4.1.4 Addressing

The address of the DLS 200 is set using the DIP switches on the IEEE 488 Interface card. Please refer to section 2.6 for complete directions on address selection.

Switch 2, position 1 to 5 is used to set the address using a binary notation. Position 5 is the msb, position 1 is the lsb.

4.2 IEEE 488.2 COMMON COMMANDS

As specified in the IEEE 488.2 specification there are a number of common commands required of devices to simplify the set up and control of standard functions of remote controlled devices. These common commands are described below.

*IDN?	Identification Query
Type :	System command
Function :	Returns the ID of the unit.
	Upon receiving this command the DLS 200 will put into the output queue the following string
	CONSULTRONICS LTD, DLS 200 (ANSI), 0, VERSION x.xx
	where :
	x.xx is the version number of the software.

The DLS 200 does not support the unit serial number reporting part of the *IDN function.

*RST	Reset
Type :	Internal command
Function :	IEEE 488.2 level three reset
	This command will set the length of the DLS 200 to 0 kft. It will not affect the output buffer or other system settings of the unit.
*TST?	Self-Test Query
Type :	Internal command
Function :	Performs a self test and returns the results.
	The DLS 200 always returns an integer 0 to the output queue as it does not have any self test capabilities.
*OPC	Operation Complete
Type :	Synchronization command
Function :	Indicates to the controller when the current operation is complete.
	This command has no effect in the DLS 200.

*OPC?	Operation Complete Query
Type :	Synchronization command
	Indicates when the current operation is complete.
This command has no effect in the DLS 200.	
*WAI	Wait to continue
Type :	Synchronization command
	Used to delay execution of commands
This command has no effect in the DLS 200.	
*DDT	Define Trigger
Type :	Trigger Command
Function :	In the DLS 200 a trigger command (see below) may optionally be used to trigger impulse hits from the impairment card. This command will define which Impairment card (terminal 1, 4, or both) will inject a hit when the trigger command is sent over the bus. The data associated with the command is either TER1, TER4, or NONE (to turn off the capability). If both sides are to inject hits, then include both TER1 and TER4. There is also a query form of the command.
	i.e. *DDT TER1 *DDT TER1,TER4 *DDT NONE *DDT?
*TRG	Trigger
Type :	Trigger Command
Function :	Trigger operation of the device If a trigger has been enabled by the DDT command, sending the *TRG command will inject one impulse hit onto the simulated line. A separate *TRG command is required for each impulse hit, unless a repetition rate greater than 0 has been programmed, in which case the impulses will be generated automatically. (See section 4.3 Device Dependant Commands for more details).
*CLS	Clear Status Command
Type :	Status
Function :	Clears the Event Status Register (ESR), and therefore also b5 of the Status Byte Register (STB). It has no effect on the output queue (b4 of the STB).
*SRE	Service Request Enable
Type :	Status
Function :	Sets the Service Request Enable Register (SRER) using an integer value, representing a sum of the bit by bit mapping of the register. Since the DLS 200 uses only b4 (message available) and b5 (Event Status) the valid values for this command are: 0 - no bits enabled 16 - b4 enabled 32 - b5 enabled 64 - b4 and b5 enabled.
*SRE?	Service Request Enable Query
Type :	Status
Function :	An integer value representing the value of the Service Request Enable Register is placed in the output queue. The possible values are listed in the previous command.
*STB?	Status Byte Query
Type :	Status
Function :	The value of the Status Byte (with b6 = MSS) is put into the output queue. This byte is only cleared by clearing the related enabling structures, namely the Event Status Register (ESR) and/or the output queue.

*ESE	Event Status Enable
Type :	Status
Function :	Sets the Event Status Enable Register (ESER) using an integer value from 0 to 255, representing a sum of the bit by bit mapping of the register. ie/ b0=1, b1=2, b2=4, b3=8, etc. The ESER masks which bits will be enabled in the Event Status Register (ESR)
*ESE?	Event Status Enable Query
Type :	Status
Function :	An integer value between 0 and 255 representing the value of the Event Status Enable Register (ESER) is placed in the output queue.
*ESR?	Event Status Register
Type :	Status
Function :	An integer value between 0 and 255 representing the value of the Event Status Register (ESR) is placed in the output queue. Once the value is placed in the queue this register is cleared.

4.3 Device Dependent Commands

The device dependant commands of the DLS 200 fall onto one of two categories. Those that set the wireline simulation circuits, and those that set the impairments. These are described in separate sections below.

The commands assume a good working knowledge of the DLS 200. For further details consult the Manual Operation section of the instructions.

4.3.1 Wireline Settings.

The wireline commands can be used to set either standard loops or to modify the settings of standard loops. The command hierarchy is to select a SET command, select a CHANNEL, then select a LOOP. If desired, further data can be added to the command to change the setting of a particular segment of the loop.

The segment numbering is taken from the DLS 200 diagrams and works from left to right including bridged taps. Referring to standard loop 1 the lengths of the loop would be:

segment 1 : 16.5
segment 2 : 1.5

The structure of the command set is shown below. Following that are several examples of setting commands.

DLS 200 Loop Setting Commands

```
: set : channel : loop0
: set : channel : loop1 : s1 (length), s2 (length)
: set : channel : loop2 : s1 (length), s2 (length), s3 (length),
: set : channel : loop3 : s1 (length), s2 (length), s3 (length), s4 (length), s5 (length), s6 (length), s7 (length), s8 (length),
                        s9 (length)
: set : channel : loop4 : s1 (length), s2 (length), s3 (length), s4 (length)
: set : channel : loop5 : s1 (length), s2 (length), s3 (length),
: set : channel : loop6 : s1 (length), s2 (length), s3 (length), s4 (length), s5 (length)
: set : channel : loop7 : s1 (length)
: set : channel : loop8 : s1 (length), s2 (length), s3 (length), s4 (length)
: set : channel : loop9 : s1 (length), s2 (length), s3 (length), s4 (length), s5 (length), s6 (length)
: set : channel : loop10 : s1 (length), s2 (length), s3 (length), s4 (length), s5 (length)
: set : channel : loop11 : s1 (length), s2 (length)
: set : channel : loop12 : s1 (length), s2 (length), s3 (length),
: set : channel : loop13 : s1 (length), s2 (length), s3 (length), s4 (length), s5 (length), s6 (length)
: set : channel : loop14 : s1 (length), s2 (length), s3 (length), s4 (length), s5 (length), s6 (length), s7 (length), s8 (length)
: set : channel : loop15 : s1 (length)
```

For example, to set standard ANSI loop 2 the command would be:

```
:SET:CHANNEL:LOOP2
```

To change the third segment of that loop the command would be:

```
:SET:CHANNEL:LOOP2 S3 1.7
```

To change the first and second segments of that loop the command would be:

```
:SET:CHANNEL:LOOP2 S1 13.9, S2 3.4
```

4.3.2 Wireline Queries

The set length of the simulator can be queried over the IEEE bus as well. Note that individual segments can be queried individually or as a group. A query of a specific loop will return the STANDARD lengths for that loop while a query of the loop that is set will return the ACTUAL lengths for that loop.

Section Query :

```
:SET:CHANNEL:LOOP2 S17
```

```
returns LOOP2:S1 13.9
```

Standard Loop Query :

```
:SET:CHANNEL:LOOP2?
```

```
returns LOOP2:S1 13.5, S2 3.0, S3 1.5
(the standard lengths)
```

Loop Query :

```
:SET:CHANNEL?
```

```
returns LOOP2:S1 13.9, S2 3.4, S3 1.7
(the actual lengths set according to the example given)
```

Unless a segment has been changed the Loop Query and the Standard Loop Query will return the same results.

4.3.3 Wireline Segment Limits

The range of wireline segment limits is listed below. Each has a possible setting of 0 length and a set range which is usually the standard setting +/- 0.4 feet in 0.2 ft steps. The last number in the line is the standard setting. Loops that do not follow this convention have all possible settings listed.

<u>Loop number</u>	<u>Range</u>	<u>Normal Value</u>
LOOP0	NONE	0
LOOP1	SEGMENT1 0, 16.1-16.9	16.5
	SEGMENT2 0, 1.1-1.9	1.5
LOOP2	SEGMENT1 0, 13.1-13.9	13.5
	SEGMENT2 0, 2.6-3.4	3.0
	SEGMENT3 0, 1.1-1.9	1.5
LOOP3	SEGMENT1 0, 7.1,7.3,7.5,7.7	7.5
	SEGMENT2 0, 5.6-6.4	6.0
	SEGMENT3 0, 0.1-0.9	0.5
	SEGMENT4 0, 1.1-1.9	1.5
	SEGMENT5 0, 0.6,0.8,1.0,1.2	1.0
	SEGMENT6 0, 0.6,0.8,1.0,1.2	1.0
	SEGMENT7 0, 1.1-1.9	1.5
	SEGMENT8 0, 0.6-1.4	1.0
	SEGMENT9 0, 0.1-0.9	0.5
LOOP4	SEGMENT1 0, 7.1,7.3,7.5,7.7	7.5
	SEGMENT2 0, 4.1-4.9	4.5
	SEGMENT3 0, 1.6-2.4	2.0
	SEGMENT4 0, 2.6-3.4	3.0

LOOP5	SEGMENT1 0, 8.6-9.4	9.0
	SEGMENT2 0, 5.6-6.4	6.0
	SEGMENT3 0, 1.1-1.9	1.5
LOOP6	SEGMENT1 0, 4.1-4.9	4.5
	SEGMENT2 0, 11.6-12.4	12.0
	SEGMENT3 0, 0.1-0.9	0.5
	SEGMENT4 0, 0.6-1.4	1.0
	SEGMENT5 0, 0.1-0.9	0.5
LOOP7	SEGMENT1 0, 13.1-13.9	13.5
LOOP8	SEGMENT1 0, 8.6-9.4	9.0
	SEGMENT2 0, 0.6,0.8,1.0,1.2	12.0
	SEGMENT3 0, 5.6-6.4	6.0
	SEGMENT4 0, 0.6,0.8,1.0,1.2	0.8
LOOP9	SEGMENT1 0, 2.6-3.4	3.0
	SEGMENT2 0, 1.1-1.9	1.5
	SEGMENT3 0, 5.6-6.4	6.0
	SEGMENT4 0, 1.1-1.9	1.5
	SEGMENT5 0, 1.1-1.9	1.5
	SEGMENT6 0, 1.1-1.9	1.5
LOOP10	SEGMENT1 0, 5.6-6.4	6.0
	SEGMENT2 0, 2.6-3.4	3.0
	SEGMENT3 0, 5.6-6.4	6.0
	SEGMENT4 0, 1.1,1.3,1.5,1.7	1.5
	SEGMENT5 0, 0.6,0.8,1.0,1.2	1.0
LOOP11	SEGMENT1 0, 11.6-12.4	12.0
	SEGMENT2 0, 1.1-1.9	1.5
LOOP12	SEGMENT1 0, 7.1,7.3,7.5,7.7	7.5
	SEGMENT2 0, 4.1-4.9	4.5
	SEGMENT3 0, 1.1-1.9	1.5
LOOP13	SEGMENT1 0, 8.6-9.4	9.0
	SEGMENT2 0, 1.6-2.4	2.0
	SEGMENT3 0, 1.1-1.9	1.5
	SEGMENT4 0, 0.1-0.9	0.5
	SEGMENT5 0, 1.1-1.9	1.5
	SEGMENT6 0, 0.1-0.9	0.5
LOOP14	SEGMENT1 0, 2.6-3.4	3.0
	SEGMENT2 0, 1.6-2.4	2.0
	SEGMENT3 0, 7.1-7.9	7.5
	SEGMENT4 0, 0.6-1.4	1.0
	SEGMENT5 0, 1.1-1.9	1.5
	SEGMENT6 0, 0.1-0.9	0.5
	SEGMENT7 0, 1.1-1.9	1.5
	SEGMENT8 0, 0.6-1.4	1.0
LOOP15	SEGMENT1 0, 11.6-12.4	12.0

4.3.4 DLS 200 Basic Loop Setting Commands

: set : channel : bas2 : s1 (gauge),(length),
 s2 (gauge),(length),
 s3 (gauge),(length),
 s4 (gauge),(length),
 s5 (gauge),(length),
 s6 (gauge),(length),
 s7 (gauge),(length),
 s8 (gauge),(length),
 s9 (gauge),(length)

```

: set : channel : bas4 :      s1 (gauge),(length),
                             s2 (gauge),(length),
                             s3 (gauge),(length),
                             s4 (gauge),(length),
                             s5 (gauge),(length),
                             s6 (gauge),(length)
: set : channel : bas22awg : s1 (gauge),(length),
                             s2 (gauge),(length),
                             s3 (gauge),(length),
                             s4 (gauge),(length),
                             s5 (gauge),(length),
                             s6 (gauge),(length),
                             s7 (gauge),(length)
: set : channel : bas24awg : s1 (gauge),(length),
                             s2 (gauge),(length),
                             s3 (gauge),(length),
                             s4 (gauge),(length),
                             s5 (gauge),(length),
                             s6 (gauge),(length),
                             s7 (gauge),(length),
                             s8 (gauge),(length)
: set : channel : bas26awg : s1 (gauge),(length),
                             s2 (gauge),(length),
                             s3 (gauge),(length),
                             s4 (gauge),(length),
                             s5 (gauge),(length),
                             s6 (gauge),(length),
                             s7 (gauge),(length),
                             s8 (gauge),(length)
: set : channel : basmax :   s1 (gauge),(length),
                             s2 (gauge),(length),
                             s3 (gauge),(length),
                             s4 (gauge),(length),
                             s5 (gauge),(length),
                             s6 (gauge),(length),
                             s7 (gauge),(length),
                             s8 (gauge),(length),
                             s9 (gauge),(length)

```

The structure of the command set is shown below. Following that are several examples of setting commands. Some maximum lengths of sections may be different. This is because there are ISDN, Multigauge 1, and Multigauge 2 cards in the unit. Look at the index on section 4.3.5 to determine the type of card and the maximum length that each card can have depending on the gauge.

<u>Loop type</u>		<u>Range</u>		<u>Normal Value</u>	
		<u>meters</u>	<u>kilofeet</u>	<u>see index in 4.3.5</u>	
BASIC 2 WIRE (Multi 2 Card)	SEGMENT1	0-2350	(0.00-7.85)	0	A
	SEGMENT2	0-2350	(0.00-7.85)	0	B
	SEGMENT3	0-350	(0.00-1.15)	0	C
	SEGMENT4	0-350	(0.00-1.15)	0	C
	SEGMENT5	0-750	(0.00-2.50)	0	D
	SEGMENT6	0-350	(0.00-1.15)	0	C
	SEGMENT7	0-350	(0.00-1.15)	0	C
	SEGMENT8	0-350	(0.00-1.15)	0	C
	SEGMENT9	0-350	(0.00-1.15)	0	C
BASIC 4 WIRE	SEGMENT1	0-350	(0.00-1.15)	0	B
	SEGMENT2	0-350	(0.00-1.15)	0	B
	SEGMENT3	0-350	(0.00-1.15)	0	B
	SEGMENT4	0-350	(0.00-1.15)	0	B
	SEGMENT5	0-350	(0.00-1.15)	0	B
	SEGMENT6	0-350	(0.00-1.15)	0	B
MAX LENGTH 22AWG (2-W)	SEGMENT1	0-350	(0.00-1.15)	350	C
	SEGMENT2	0-350	(0.00-1.15)	350	C
	SEGMENT3	0-750	(0.00-2.50)	750	D
	SEGMENT4	0-350	(0.00-1.15)	350	C
	SEGMENT5	0-350	(0.00-1.15)	350	C
	SEGMENT6	0-350	(0.00-1.15)	350	C
	SEGMENT7	0-350	(0.00-1.15)	350	C

MAX LENGTH 24 AWG (2-W)	SEGMENT1	0-2350	(0.00-7.85)	2350	B
	SEGMENT2	0-750	(0.00-2.50)	750	C
	SEGMENT3	0-750	(0.00-2.50)	750	C
	SEGMENT4	0-350	(0.00-1.15)	350	D
	SEGMENT5	0-750	(0.00-2.50)	750	C
	SEGMENT6	0-750	(0.00-2.50)	750	C
	SEGMENT7	0-750	(0.00-2.50)	750	C
	SEGMENT8	0-750	(0.00-2.50)	750	C
MAX LENGTH 26 AWG (2-W)	SEGMENT1	0-2350	(0.00-7.85)	2350	A
	SEGMENT2	0-750	(0.00-2.50)	750	C
	SEGMENT3	0-750	(0.00-2.50)	750	C
	SEGMENT4	0-750	(0.00-2.50)	750	C
	SEGMENT5	0-750	(0.00-2.50)	750	C
	SEGMENT6	0-750	(0.00-2.50)	750	C
	SEGMENT7	0-750	(0.00-2.50)	750	C
	SEGMENT8	0-750	(0.00-2.50)	750	C
MAX LENGTH	SEGMENT1	0-2350	(0.00-7.85)	2350	A
	SEGMENT2	0-2350	(0.00-7.85)	2350	B
	SEGMENT3	0-350	(0.00-1.15)	350	C
	SEGMENT4	0-350	(0.00-1.15)	350	C
	SEGMENT5	0-750	(0.00-2.50)	750	D
	SEGMENT6	0-350	(0.00-1.15)	350	C
	SEGMENT7	0-350	(0.00-1.15)	350	C
	SEGMENT8	0-350	(0.00-1.15)	350	C
	SEGMENT9	0-350	(0.00-1.15)	350	C

Each section on the Basic Loops may or may not have their gauges changed. The index provided will give an idea of the maximum length for every gauge of each section that is available.

4.3.5 INDEX

- A) The 26 fixed gauge ISDN toggles up to 2350m or 7.85kft. Although the parser needs a gauge value, this value will have no effect.
- B) The 24 fixed gauge ISDN toggles up to 2350m or 7.85kft. Although the parser needs a gauge value, this value will have no effect.
- C) The 22 gauge toggles up to 350m or 1.15kft and the 24 and 26 gauge toggles up to 750m or 2.50kft.
- D) The 24 gauge toggles up to 350m or 1.15kft and the 22 and 26 gauge toggles up to 750m or 2.50kft.

TABLE OF VALUES

A full table of possible values for setting each card is given below :

Length Steps For ISDN Cards			
<u>kilofeet</u>	<u>meters</u>	<u>kilofeet</u>	<u>meters</u>
0.00	0	4.00	1200
0.15	50	4.15	1250
0.35	100	4.35	1300
0.50	150	4.50	1350
0.65	200	4.65	1400
0.85	250	4.85	1450
1.00	300	5.00	1500
1.15	350	5.15	1550
1.35	400	5.35	1600
1.50	450	5.50	1650
1.65	500	5.65	1700
1.85	550	5.85	1750
2.00	600	6.00	1800
2.15	650	6.15	1850
2.35	700	6.35	1900
2.50	750	6.50	1950
2.65	800	6.65	2000
2.85	850	6.85	2050
3.00	900	7.00	2100
3.15	950	7.15	2150
3.35	1000	7.35	2200
3.50	1050	7.50	2250
3.65	1100	7.65	2300
3.85	1150	7.85	2350

Length Steps For Multigauge Cards

<u>kilofeet</u>	<u>meters</u>
0.00	0
0.15	50
0.35	100
0.50	150
0.65	200
0.85	250
1.00	300
1.15	350
1.35	400
1.50	450
1.65	500
1.85	550
2.00	600
2.15	650
2.35	700
2.50	750

Basic Loops have the ability to accept commands in either Meters or Kilofeet.

For example, to set Basic Loop 2 section 2 in meters, the command would be :

```
:SET:CHANNEL:BAS2 S1 26, 2350m
```

To set Basic Loop 2 section 2 in kilofeet, the command could be :

```
:SET:CHANNEL:BAS2 S2 24, 3.85kft
```

To change the first and second segments of that loop the command would be :

```
:SET:CHANNEL:BAS2 S1 26, 2350m, S2 24, 3.85kft
```

For this example, the units mode of the system will be in kilofeet since the last section set was in kilofeet. The first section will be converted to 7.85 kilofeet, the equivalent value of 2350 meters.

UNITS CHANGE

Another alternative to setting the Basic Loops in either meters or feet, is by using the Device Dependent command :

```
:UNIT:LENGTH:METER or
:UNIT:LENGTH:FEET
```

For example, the equivalent set of commands will perform the same as the previous example :

```
:UNIT:LENGTH:METER
:SET:CHANNEL:BAS2 s1 26, 2350
:UNIT:LENGTH:FEET
:SET:CHANNEL:BAS2 s2 24, 3.85
```

To query the units, one would type :

```
:UNIT:LENGTH?
```

4.3.6 Impairment Commands

The format of the Impairment commands are listed in sections 4.3.7 and 4.3.8. Note that the set for Terminal 4 has two extra commands which set the frequency of the longitudinal noise, the dual tones, and the voltage of the longitudinal noise.

We have recently improved the impairment cards, and the IEEE command sets are slightly different. You need to follow the instructions which apply to your card. The easiest way to distinguish which card you have is go to front panel control of the unit, and put the impairments display on the screen. If LF Emphasize noise is displayed the commands you need are described in 4.3.7. Otherwise they are described in 4.3.8.

4.3.7 Commands for Earlier Version Impairment Cards**I) For Terminal 1**

```
:source :ter1 :external (type), (level)
:source :ter1 :xtalk (type), (level)
:source :ter1 :impulse (type), (rate), (level)
:source :ter1 :tone (freq1), (freq2), (level)
:source :ter1 :lfnoise (level)
```

For Terminal 4

```
:source :ter4 :external (type), (level)
:source :ter4 :xtalk (type), (level)
:source :ter4 :impulse (type), (rate), (level)
:source :ter4 :tone (freq1), (freq2), (level)
:source :ter4 :lfnoise (level)
:source :ter4 :pwrfreq (freq)
:source :ter4 :longitudinal (level), (ext), (inj)
```

- II) EXTERNAL: Used for the control of the external input. It is set to select either an external signal, a hit trigger, or none.

```
EXTERNAL NONE
EXTERNAL TRIGGER
EXTERNAL SIGNAL, (0 TO 60)
```

- III) XTALK: Sets the type and level of the White noise generator. There are three types of noise, and within the Flat noise setting there are two sets of units.

```
XTALK FLAT, (-71.3 TO -131.3) in dB's
XTALK FLAT, (0.0 TO 100.0) in V/√Hz
XTALK ANSIFULL, (-15.0 TO 20.0)
XTALK ANSI320, (-15.0 TO 20.0)
```

- IV) IMPULSE: Sets the type and level of the Impulse noise.

```
IMPULSE TRILVL, (0 TO 100), (0.0 TO 100.0)
IMPULSE BIPOL50, (0 TO 100), (0.0 TO 100.0)
IMPULSE BIPOL37, (0 TO 100), (0.0 TO 100.0)
IMPULSE UNIPOLNEG, (0 TO 100), (0.0 TO 100.0)
IMPULSE UNIPOLPOS, (0 TO 100), (0.0 TO 100.0)
```

- V) TONE: Sets the level and the frequency of the tones generator. The format of the command changes according to whether single or dual tones have been selected.

- a) SINGLE
TONE (0 to 1000), 0, (-40.0 to -100.0)

NOTE : Remember that to the second parameter must be zero to generate Single Tones.

- b) DUAL, PWRFREQ = 50 Hz

```
TONE (off,50,150,250,350,450,550),
      (off,50,150,250,350,450,550),
      (-15.0 to 9.0)
```

- c) DUAL, PWRFREQ = 60 Hz

```
TONE (off,60,180,300,420,540,660),
      (off,60,180,300,420,540,660),
      (-15.0 to 9.0)
```

- VI) LFNOISE: This is a special noise that has the level in the lower frequency spectrum emphasized.

```
LFNOISE (-15.0 TO 9.0)
```

- VII) PWRFREQ: This command sets the frequency of the longitudinal noise generator and sets the frequency pairs for the DUAL tone feature.
- PWRFREQ (50 or 60)
- VIII) LONGITUDINAL: Sets the level of the longitudinal noise. The additional parameter (on/off) is used to indicate whether the longitudinal signal is generated internally (on) or externally (off). The last parameter (T3/T4) will turn on the Common Mode Injection to the center of the Standard Loop (T3/T2) or to (T4).
- LONGITUDINAL (0 TO 60), (ON,OFF), (T3,T4)

Some examples:

```
:SOURCE:TER4:EXTERNAL SIGNAL,45
:SOURCE:TER1:EXTERNAL TRIGGER
:SOURCE:TER4:XTALK:ANSIFULL,-10.0,DB
:SOURCE:TER1:IMPULSE BIPOL50,25,75.0
:SOURCE:TER4:PWRFREQ 60
:SOURCE:TER4:LONGITUDINAL 47,ON,T3
:SOURCE:TER1:TONE:820,0,-50.0
:SOURCE:TER1:TONE:180,300,-12.0
```

Some points to note about the Device Dependent Commands:

The command may be sent in upper or lower case form.

The unit will round any data of greater than needed precision to the required number of places.

4.3.8 Commands for Later Impairment Cards

- I) **For Terminal 1**
- ```
:source :ter1 :external (type), (level)
:source :ter1 :xtalk (type), (level)
:source :ter1 :impulse (type), (rate), (level), (width)
:source :ter1 :tone (freq1), (freq2), (level)
```
- For Terminal 4**
- ```
:source :ter4 :external (type), (level)
:source :ter4 :xtalk (type), (level)
:source :ter4 :impulse (type), (rate), (level), (width)
:source :ter4 :tone (freq1), (freq2), (level)
:source :ter4 :pwrfreq (freq)
:source :ter4 :longitudinal (level), (ext), (inj)
```
- II) EXTERNAL: Used for the control of the external input. It is set to select either an external signal, a hit trigger, or none.
- NONE
TRIGGER
SIGNAL, (0 TO 60)
XTALK
- III) XTALK: Sets the type and level of the White noise generator. There are four types of noise, and within the Flat noise setting there are two sets of units.
- FLAT, (-71.3 TO -131.3) in dB's
FLAT, (0.0 TO 100.0) in V/√Hz
HDSL, (-21.0 TO -56.0)
ANSIFULL, (-15.0 TO 20.0)
DSL, (-30.0 TO -62.8)
- IV) IMPULSE: Sets the type and level of the Impulse noise.
- TRILVL, (0 TO 100), (0.0 TO 100.0), (22 TO 120)
BIPOL, (0 TO 100), (0.0 TO 100.0), (22 TO 120)
UNIPOLNEG, (0 TO 100), (0.0 TO 100.0), (22 TO 120)
UNIPOLPOS, (0 TO 100), (0.0 TO 100.0), (22 TO 120)

- V) TONE: Sets the level and the frequency of the tones generator. The format of the command changes according to whether single or dual tones have been selected.
- a) SINGLE
- TONE (0 to 1000), 0, (-40.0 to -100.0)
- NOTE : Remember that to the second parameter must be zero to generate Single Tones
- b) DUAL, PWRFREQ = 50 Hz
- TONE (off,50,150,250,350,450,550),
(off,50,150,250,350,450,550),
(-15.0 to 9.0)
- c) DUAL, PWRFREQ = 60 Hz
- TONE (off,60,180,300,420,540,660),
(off,60,180,300,420,540,660),
(-15.0 to 9.0)
- VII) PWRFREQ: This command sets the frequency of the longitudinal noise generator and sets the frequency pairs for the DUAL tone feature.
- PWRFREQ (50 or 60)
- VIII) LONGITUDINAL: Sets the level of the longitudinal noise. The additional parameter (on/off) is used to indicate whether the longitudinal signal is generated internally (on) or externally (off). The last parameter (T3/T4) will turn on the Common Mode Injection to the center of the Standard Loop (T3/T2) or to (T4).
- LONGITUDINAL (0 TO 60), (ON,OFF), (T3,T4)

Some examples:

```
:SOURCE:TER4:EXTERNAL SIGNAL,45
:SOURCE:TER1:EXTERNAL TRIGGER
:SOURCE:TER4:XTALK:ANSIFULL,-10.0
:SOURCE:TER1:IMPULSE BIPOL 25,75.0,50
:SOURCE:TER4:PWRFREQ 60
:SOURCE:TER4:LONGITUDINAL 47,ON,T4
:SOURCE:TER1:TONE:820,0,-50.0
:SOURCE:TER1:TONE:180,300,-12.0
```

Some points to note about the Device Dependent Commands:

The command may be sent in upper or lower case form.

The unit will round any data of greater than needed precision to the required number of places.

Settings of the Impairment Cards

- I) The settings of the impairment cards can be queried by the following commands :

For Terminal 1

```
": source : ter1 : external?"
": source : ter1 : xtalk?"
": source : ter1 : impulse?"
": source : ter1 : tone?"
```

For Terminal 4

```
": source : ter4 : external?"
": source : ter4 : xtalk?"
": source : ter4 : impulse?"
": source : ter4 : tone?"
": source : ter4 : pwrfreq?"
": source : ter4 : longitudinal?"
```

- II) Querying all the settings of the cards for terminal 1 and terminal 4 can be done with the following commands :

```
": source : ter1?"
": source : ter4?"
```

4.4 STATUS REPORTING

While at first glance the Status reporting mechanisms of IEEE 488.2 may seem complicated, they are in fact very simple, and it is mostly the nomenclature that is a bit cryptic. There are two main structures that record and report status, the Status Byte Register (STB), and the Event Status Register (ESR). If the Event Status Register is non zero (ie/ a defined and enabled event has occurred) this fact, at the users discretion, may be reflected in the Status Byte Register.

As well, each register has an enabling byte, which allows the user to control which events will activate the byte. There is a command to set this enabling byte, and one to read it. Thus, for each Register there are three commands, one to read the register, one to set the enabling byte, and one to read the enabling byte.

4.4.1 Status Byte Register (STB)

i) Status Byte Register STB

The bits of this register are mapped as follows :

- bit 6** This bit is the Master Summary Status (MSS) when the STB is sent in response to a IEEE 488.2 Status Byte Query command (*STB?). It indicates that the device has at least one reason to request service
or
This bit is the Request Service bit (RQS), when the STB is sent in response to a IEEE 488.1 Serial Poll command
The only difference is that the MSS bit is not cleared by the *STB? command, whereas the RQS bit is cleared by the Serial poll command
- bit 5** Event Status Bit
It indicates that the Event Status Register is non zero i.e. that an enabled event has occurred. Note that there are two levels of masking for event status bits. For an event to set RQS (b6 of the STB) and cause a service request the appropriate bit must be enabled by the Event Status Enable Register (ESER) and the Event Status Register bit must be enabled by the Service Request Enable Register (SRER).
- bit 4** Message Available Bit
Indicates that the Output Queue is not empty.

bit 7, bit 3, bit 2, bit 1, and bit 0 are not used by the DLS 200.

ii) Service Request Enable Register (SRER)

The Service Request Enable Register is used to enable generation of SRQ (Service Request). The bits of the Status Byte Register represent events. If an event occurs and the corresponding Service Request Enable Register bit has been set, SRQ will occur. Since bit 4 and bit 5 are the only bits of the Status Byte Register that can be set there are only 4 values for the SRER, which is set by the Service Request Enable command (*SRE). The values are :

0	no events will enable service request.
16	bit 4 (output queue not empty) will cause a service request.
32	bit 5 (Event Status Register non zero) will cause a service request.
64	bit 4 or bit 5 will cause a service request.

The setting of the Service Request Enable Register can be checked with the Service Request Enable Query command (*SRE?). This will put the value of the SRER in the output queue.

iii) General STB information

As outlined above, bit 6 (RQS) of the STB will go high when bit 4 or bit 5 have been enabled and the event they represent has occurred. RQS going high will always cause the SRQ line on the IEEE 488.1 interface to go high (i.e. they will be tied together). If this is not desired set *SRE = 0 and poll the system status with *STB?.

The IEEE 488.1 Serial Poll only clears bit 6 of the STB. To clear the whole byte read all pending data from the output queue (clear bit 4) and use the *CLS command to clear the Event Status Register (clear bit 5).

4.4.2 Event Status Register (ESR)

i) Event Status Register

The Event Status Register monitors events within the system and reports on those enabled. It records transitory events as well. The DLS 200 implements only the IEEE 488.2 Standard Event Status Register (ESR). It is defined as:

- bit 7** Power on. Since the ESR was last read the power to the unit has been turned off and back on again.
- bit 6** User Request. Indicates that the user has activated a Device Defined control through the front panel. The DLS 200 does not set this bit.
- bit 5** Command Error. Either a syntax error (order of command words) or a semantic error (spelling of command words) has occurred. A GET (Group Execute Trigger, or *TRG) command inserted in a command line will also set this bit.
- bit 4** Execution Error. The data associated with a command was out of range or does not exist.
- bit 3** Device Dependent Error. At this time there are no device dependent errors in the DLS 200, so this bit is always 0.
- bit 2** Query Error. There was an attempt to read an empty Output queue or there was an output queue overflow.
- bit 1** Request Control. The DLS 200 does not have the ability to control the IEEE bus, and so this bit is always 0.
- bit 0** Operation Complete. The DLS 200 does not set this bit.

ii) Event Status Enable Register

The Event Status Enable Register (ESER) is used to set the ESB bit of the Status Bit Register. The bits of the Event Status Register represent events. If an event occurs and the corresponding Event Status Enable Register has been set, then the ESB bit will be set. The command used for this purpose is the Event Status Enable command (*ESE). The value used to set the register is an integer value from 0 to 255, representing a sum of the bit by bit mapping of the register. i.e. bit 0=1, bit 1=2, bit 2=4, bit 3=8 etc. The ESER masks which bits will be enabled in the Event Status Register (ESR).

Although not all the bits in the ESR are used by the DLS 200, for simplicity sake all of them can be enabled. When polled however, the non active bits (bit 7, bit 3, bit 1) will always return a value of 0.

The setting of the Event Status Enable Register can be checked with the Event Status Enable Query command (*ESE?). This will put the value of the ESER in the output queue.

iii) General ESR Information

The Event Status Register (ESR) is only cleared by reading the register (*ESR?) or by clearing it (*CLS).

For more information on Status reporting see section 4.2) IEEE 488.2 Common Commands.

The following references provide detail information on the IEEE interface :

- (1) ANSI/IEEE 488.1-1987 IEEE Standard Digital Interface for Programmable Instrumentation"
- (2) ANSI/IEEE 488.2-1987 "IEEE Codes, Formats, Protocols, and Common Commands"
- (3) "Standard Commands for Programmable Instruments" (SCPI), available from some interface controller manufacturers.

Section 5 WARRANTY

Consultronics warrants all equipment bearing its nameplate to be free from defects in workmanship and materials, during normal use and service, for a period of twelve (12) months from the date of shipment. In the event that a defect in any such equipment arises within the warranty period it shall be the responsibility of the customer to return the equipment by prepaid transportation to a Consultronics service centre prior to the expiration of the warranty period for the purpose of allowing Consultronics to inspect and repair the equipment. If inspection by Consultronics discloses a defect in workmanship or material it shall, at its option, repair or replace the equipment without cost to the customer, and return it to the customer by the least expensive mode of transportation, the cost of which shall be prepaid by Consultronics. In no event shall this warranty apply to equipment which has been modified without the written authorization of Consultronics, or which has been subjected to abuse, neglect, accident or improper application. If inspection by Consultronics discloses that the repairs required to be made on the equipment are not covered by this warranty, the regular repair charges shall apply to any repairs made to the equipment.

This warranty constitutes the only warranty applicable to the equipment sold by Consultronics and no other warranty or condition, statutory or otherwise, express or implied shall be imposed upon Consultronics nor shall any representation made by any person including a representation by a representative or agent of Consultronics be effective to extend the warranty coverage provided herein. In no event (including, but not limited to the negligence of Consultronics, its agents or employees) shall Consultronics be liable for special consequential damages or damages arising from the loss of use of the equipment and on the expiration of the warranty period all liability of Consultronics whatsoever in connection with the equipment shall terminate.

If warranty service becomes necessary, please phone or fax Consultronics to get return authorization number and shipping instructions :

Consultronics Ltd. (Head Office)

*160 Drumlin Circle
Concord, Ontario, Canada
L4K 3E5
Phone : (905) 738-3741 or
Toll Free 1-800-267-7235
Fax : (905) 738-3712*

Consultronics Ltd. (Ottawa Office)

*169 Colonnade Rd.,
Nepean, Ontario, Canada
K2E 7J4
Phone : (613) 225-6087 or
Toll Free 1-800-465-1796
Fax : (613) 225-6315*

Consultronics (U.S.A. Office)

*269 Portage Rd.,
Lewiston, NY
14092
Phone : Toll Free 1-800-267-7235*

Consultronics (Europe Office)

*Unit A
Omega Enterprise Park
Electron Way
Chandlers Ford
Hampshire, England
SO5 3SE
Phone : 0703 270222
Fax : 0703 270333*

or your local Consultronics representative

Section 6 SHIPPING THE DLS 200

If the instrument is to be shipped on a regular basis, a transit case is recommended.

To prepare the DLS for shipment, turn the power off and disconnect all cables including power cable.

Be sure to remove the program disk from the drive. Protect the disk with suitable packaging and put it together with the instrument.

If a transit case is not available, pack the instrument in the original carton. Do not place any cables or accessories directly against the front panel as this may scratch the surface of the display. It is suggested that you mark all shipments with labels indicating that the contents are fragile.

Section 7 *SERVICING THE DLS 200*

NOTE: POWER MUST BE OFF BEFORE CIRCUIT BOARDS MAY BE REMOVED OR REPLACED.

The DLS has been designed for ease of servicing. The unit is very modular in design and circuit functions are divided among different boards. Problems can be traced to each individual board, and defective boards can be quickly isolated.

To access to the hardware, unplug the unit and remove the four Allen head screws located on the two sides of the top cover. Two of the screws are hidden inside the side support legs, and the plastic legs have to be removed to access those screws. The top cover will come off once the screws are removed.

WARNING: The DLS contains electronic components which are protected against static damage while properly installed in the unit. Before touching any component or removing a circuit board insure that you and the environment are static free. By doing this, component damage can be avoided. To ship circuit boards use an anti-static plastic bag or wrap the board in aluminum foil.

The DLS is modular in design. If a problem should occur, Consultronics should be notified of the problem. We will then recommend the action to be taken. In most cases, a replacement board will be dispatched to solve the problem.

To replace a board, remove the 3 screws holding the rear card guide, and loosen the screws holding the card guide at the front. The front card guide can then be moved forward, and the board pulled out. Be careful not to loose any of the screws inside the machine! The reverse procedure is used to re-insert a board.

Section 8 SPECIFICATIONS

LENGTH OF SIMULATED LINE

Fixed Length Cards:	2 cards (one 24 gauge and one 26 gauge) - up to 7.85 kft long, variable in 0.15 kft increments.
Multigauge Cards:	6 cards - up to 2.5 kft of 24 and 26 AWG and 1.15 kft of 22 AWG, 1 card - up to 2.5 kft of 22 and 26 AWG and 1.15 kft of 24 AWG.
Cable Type Simulated :	22, 24 and 26 AWG

IMPAIRMENT MODULE

(a) Filtered Random Noise :

Flat Spectrum :	Flat 100Hz to 500kHz.
Level (3kHz flat weighted) :	-131.3 to -71.3 dBm/Hz in 0.1 dB steps (or 0.1 to 100 μ V / $\sqrt{\text{Hz}}$ in 0.1 steps) or off.
Level Accuracy :	$\pm$ 2% of setting.
Crosstalk Spectrums :	2 Types of NEXT: T1.601/1991 LB Draft Rev & T1.601/1991 LB Draft Rev. with 320 kHz bandpass. measured to 320 kHz, 20.0 to -15.0 dB in 0.1 dB steps relative to ANSI reference level.

(b) Impulse Noise :

Type:	4 standard pulses to choose from.
Level :	0.05 to 100.0mVp in 0.1mV steps or off.
Rate :	1 to 100 pps, single shot, or externally triggered to 2000 pps.
Pulse Shapes :	3 - Level, Bipolar pulse variable from 22 to 120 μ sec., +ve & -ve Unipolar pulse

(c) Sinewave Generation :

Single Frequencies :	50 to 999 Hz in 1 Hz steps.
Level :	-40.0 to -100.0 dBm in 0.1dB steps.

(d) Power Related Metallic Noise

Type:	Dual tone as per ANSI T1.601/1991 LB rev.
Level:	+9.0 db to -15 db in 0.1 dB steps relative to ANSI reference levels.

(e) Longitudinal Noise

Type:	Triangular waveform
Level	0 to 60 Vrms in 1 volt steps.
Frequency:	50 or 60 Hz.

Externally Generated Impairments : Any signal in the range of 700 kHz, with level within the range of $\pm$ 5 V

TEMPERATURE RANGE

10 deg. C - 40 deg. C.

SIZE

7" x 17.5" x 15" or 178mm x 444.5mm x 381mm (Height x Width x Depth).

APPENDIX

A.1 INTERPRETATION OF LEVEL UNITS

This section explains the relation between the simulator setting and the real noise it represents.

In all cases the objective is to choose a setting that corresponds to the reading of a level meter connected to the equipment. Since we know that the noise SOURCE is unchanged, the reading will only change according to the bandwidth and the impedance of the meter (designated the Load Impedance).

In Impairment modules the units used in setting levels are designed to give a compromise between commonly used units and those that are unambiguous.

There are three forms of Units that are used.

- 1) $\text{mV}/\sqrt{\text{Hz}}$ - Is independent of the Load Impedance and the bandwidth of the measuring device. It therefore requires the most manipulation to be translated into a meter reading.
- 2) dBm/Hz - Is independent of the bandwidth of the meter but not of the impedance. Therefore, when using a setting of $x \text{ dBm/Hz}$ the Load Impedance must be previously defined.
- 3) dBm - Is related to both Load Impedance and bandwidth. When using a setting of $x \text{ dBm}$ the Load Impedance and the bandwidth must both have been previously defined.

Following is a set of examples on how to convert a unit to dBm , the most common readout of level meters.

1) $\text{mV}/\sqrt{\text{Hz}}$ to dBm

For this example we will assume that the load impedance is 135Ω and the bandwidth is 3 KHz .

Assume that the setting is $10 \text{ mV}/\sqrt{\text{Hz}}$:

$$\begin{aligned} V * V &= (\text{mV} / \sqrt{\text{Hz}}) * (\text{mV} / \sqrt{\text{Hz}}) * \text{Bandwidth} \\ &= (10\text{E-}6) * (10\text{E-}6) * 3000 \\ &= 3.00\text{E-}7 \end{aligned}$$

$$\begin{aligned} P(\text{load}) &= V * V / R && \text{watts} \\ &= (3.00\text{E-}7) / 135 && \text{watts} \\ &= 2.22\text{E-}9 && \text{watts} \end{aligned}$$

$$P(\text{ref}) = 1\text{E-}3 \quad \text{watts}$$

$$\begin{aligned} \text{dBm} &= 10 * \text{LOG} [P(\text{load})/P(\text{ref})] && \text{dBm} \\ &= 10 * \text{LOG} [(2.22\text{E-}9)/(1\text{E-}3)] && \text{dBm} \\ &= -56.5 && \text{dBm} \end{aligned}$$

2) dBm/Hz to dBm

Here we will assume that the bandwidth is 3000 Hz and the setting is -70 dBm/Hz .

$$\begin{aligned} \text{dBm} &= \text{dBm/Hz} + 10 * \text{LOG} (\text{bandwidth}) && \text{dBm} \\ &= -70.0 + 10 * \text{LOG} (3000) && \text{dBm} \\ &= -70.0 + 34.8 && \text{dBm} \\ &= -35.2 && \text{dBm} \end{aligned}$$

Loading

As can be seen from the above discussion the choice of loads plays a large part in the level that the meter will read. The following are loads that are assumed to be in place for Consultronics DLS 200 Noise generators. (In all cases any wirelines in place are set to zero length).

For the ANSI FULL BW NEXT, the loading is one 135Ω resistor and one complex impedance as described in the text.

For all other noises the loading is two 135Ω resistors in parallel.

Notes

- A) To change a level in $\text{mV}/\sqrt{\text{Hz}}$ by a certain number of dB use the following formula : (Assume x is the amount to change the $\text{mV}/\sqrt{\text{Hz}}$ setting by and the dB change required is -6 dB.)

$$\begin{aligned}x &= 10^{**} (y / 20) \\&= 10^{**} (-6 / 20) \\&= 0.50\end{aligned}$$

Therefore the original setting in $\text{mV}/\sqrt{\text{Hz}}$ should be multiplied by 0.50 to give a change of -6 dB.

- B) To change a level in dBm/Hz by a certain number of dB simply change the dBm/Hz setting by the required amount. An examination of the formula on the previous section will bear this out.

A.2 COMMONLY ASKED QUESTIONS & ANSWERS

- Q) How much will an impairments module affect the signals travelling along the wireline?

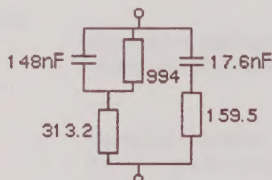
- A) It depends on the loop, the frequency, and the impedance of the modems being tested. For frequencies above 100 kHz, and with a Receiver / Transmitter that provides 135 Ω , connecting the impairments generator reduces the signal at the receiver by 0.14 dB.

- Q) How can I disconnect the Impairments module completely from the simulated loop?

- A) Turn off all impairments.

- Q) What loads do you use to calibrate impairments.

- A) In general, we set the DLS 200 to a loop length of 0, and provide a 67.5 Ω load at the terminal, T1 or T4 where the generator is located. Then we measure the voltage. For two types of impairments specified by ANSI, (Crosstalk Noise type ANSI FULL BW, and Powerline Noise type ANSI) we use 135 Ω in parallel with the ANSI load specified (shown here) :



- Q) How does wideband noise in dBm/Hz relate to total noise in dBm ?

- A) See appendix A1

- Q) Does the loop selected affect the noise level output by the Impairments module?

- A) Yes. Since impairments are injected from a 4.05 k Ω impedance, the power injected on to the loop depends heavily on that impedance. Different loops have different impedances.

- Q) Why is the noise not at the calibrated level when injected on to a simulated line?

- A) No real loop provides the same load is not the same as is used for calibrating the module, with the possible exception of the ANSI special load, and one of the ANSI loops.

- Q) Why do I have to use a balanced meter to measure noise levels from the DLS 200? (What happens if I just use the meter that I already have?)

- A) The Transmitter/Receivers under test provide a balanced load, so we should measure them the same way. Most meters ground one connection. This upsets the simulation at the higher frequencies. Even if the meter is "floating", it may be that capacitance to ground from one lead is more than the other, and this can lead to wrong answers.

NOTES

MP MASTER



MA26475